

CLAIMS

1. A semiconductor laser apparatus comprising:

a semiconductor laser;

5 a light intensity detection element for detecting
the intensity of output light from the semiconductor
laser;

2 a gain variable type error detection circuit
having an input terminal to which a control signal for
drive-controlling the semiconductor laser is input, and
10 a negative feedback input terminal to which an output
signal from the light intensity detection element is
input, for outputting an error signal corresponding to
a difference between the two input signals;

3 a high-frequency signal generating circuit for
15 generating a high-frequency signal having a
predetermined frequency;

4 a high-frequency signal superimposing circuit for
superimposing the high-frequency signal onto the output
signal from the error detection circuit; and

20 a laser drive circuit for supplying a drive
current to the semiconductor laser on the basis of the
output signal from the high-frequency signal
superimposing circuit.

25 2. A semiconductor laser apparatus according to
claim 1, wherein the error detection circuit includes a
gain controllable operation amplifying circuit and a
gain-fixed type control amplifying circuit connected to

a next stage to the operation amplifying circuit.

3. A semiconductor laser apparatus according to claim 2, wherein the high-frequency signal superimposing circuit includes:

5 a differential amplifying circuit, including differential paired transistors having bases one of which receives an output signal of the gain-fixed type control amplifying circuit and an other of which receives an input signal to a reversal input terminal
10 of the gain-fixed type control amplifying circuit, and having emitters which receive high-frequency signals output from the high-frequency signal generating circuit as differential signals, for performing a current addition; and

15 an emitter follower circuit for buffer-amplifying the output signal of the differential amplifying circuit.

4. A semiconductor laser apparatus according to claim 2, wherein the high-frequency signal
20 superimposing circuit includes:

 a first NPN transistor having a base connected to an output terminal of the control amplifying circuit;
 a second NPN transistor having a base connected to a reversal input terminal of the control amplifying
25 circuit;

 a first constant current source connected between an emitter of the first NPN transistor and a ground

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node;

a second constant current source connected between an emitter of the second NPN transistor and a ground node;

5 a third NPN transistor having a collector-emitter connected between a power node and a collector of the first NPN transistor;

an internal power for applying a bias voltage to a base of the third NPN transistor;

10 a first resistor element connected between the emitter of the third NPN transistor and a collector of the second NPN transistor;

a second resistor element connected between an emitter of the first NPN transistor and the emitter of the second NPN transistor;

15 first and second phase adjusting circuits for supplying the high-frequency signals output from the high-frequency signal generating circuit as differential signals, to the emitter of the first NPN transistor and the emitter of the second NPN transistor; and

20 an emitter follower circuit for buffer-amplifying an output signal of the collector of the second NPN transistor.

25 5. A semiconductor laser apparatus, according to claim 4, wherein the internal power generates an internal power voltage which involves a voltage drop of

a diode row in which diodes corresponding to a stage number + 1 of the emitter followers constituting the emitter follower circuit, are connected in series.

6. An information recording/reproducing apparatus comprising:

5 a semiconductor laser apparatus including: a semiconductor laser; a light intensity detection element for detecting the intensity of output light from the semiconductor laser; a gain variable type error detection circuit having an input terminal to which a control signal for drive-controlling the semiconductor laser is input, and a negative feedback input terminal to which an output signal from the light intensity detection element is input, for outputting an error signal corresponding to a difference between the two input signals; a high-frequency signal generating circuit for generating a high-frequency signal having a predetermined frequency; a high-frequency signal superimposing circuit for superimposing the high-frequency signal onto the output signal from the error detection circuit; and a laser drive circuit for supplying a drive current to the semiconductor laser on the basis of the output signal from the high-frequency signal superimposing circuit;

25 an optical system for irradiating output light from the semiconductor laser apparatus onto a recording medium;

a reproduction signal generating section for generating a reproduction signal based on an output from the detection section; and

7. A semiconductor laser apparatus comprising:

a light intensity detection element for detecting
the intensity of output light from the semiconductor
laser;

an amplifying circuit having a non-reversal input terminal and a reversal input terminal to which predetermined signals are respectively input, and to the reversal input terminal; an output signal from the light intensity detection element is input as a negative feedback signal;

a laser drive circuit for supplying a drive current to the semiconductor laser on the basis of the output signal from the amplifying circuit; and

a modulation signal current generating section for outputting a modulation signal current for adjusting an amount of output light of the semiconductor laser to the reversal input terminal of the amplifying circuit.

8. A semiconductor laser apparatus according to

claim 7, wherein the modulation signal current
generating section includes a switch element and a
current source connected in series, between the
reversal input terminal of the amplifying circuit and a
5 ground node, the switch element being intermittently
controlled by a modulation signal for controlling the
switching of irradiation of a laser beam by the
semiconductor laser.

9. A semiconductor laser apparatus according to
10 claim 7, wherein the modulation signal current
generating section includes a switch element and a
current source connected in series, between the
reversal input terminal of the amplifying circuit and a
ground node, the switch element comprising two
15 transistors constituting a differential pair, and
having differential input terminals to which modulation
signals for intermittent control are input.

10. A semiconductor laser apparatus according to
claim 7, wherein the modulation signal current
20 generating section includes a current-current
conversion circuit for converting in a current-to-
current manner, a control input signal from outside,
and outputting a converted signal to the reversal input
terminal of the amplifying circuit.

25 11. A semiconductor laser apparatus according to
claim 7, wherein the modulation signal current
generating section includes: a first conversion circuit

for receiving a control input signal from outside, and for supplying a first current conversion output to the reversal input terminal of the amplifying circuit; and a second conversion circuit for receiving the first current conversion output from the first current-current conversion circuit, and supplying a drive voltage for controlling the driving of the laser drive circuit.

12. A semiconductor laser apparatus according to claim 7, wherein the modulation signal current generating section includes: a switch element, intermittently controlled by a modulation signal for controlling the switching of irradiation of a laser beam by the semiconductor laser, and a voltage-current conversion circuit, which are connected in series between the reversal input terminal of the amplifying circuit and a ground node.

13. A semiconductor laser apparatus according to claim 7, further comprising:

a reference voltage generating circuit; and input resistors having substantially a same resistance value, and respectively connected between an output terminal of the reference voltage generating circuit and each of the non-reversal input terminal and the reversal input terminal of the amplifying circuit.

14. A semiconductor laser apparatus according to claim 13, wherein the amplifying circuit includes: a

gain controllable operation amplifying circuit having a non-reversal input terminal and a reversal input terminal, to which the reference voltages are input respectively via the input resistors, and to the reversal input terminal, an output signal of the light intensity detection element being input as a negative feedback signal; and a gain-fixed type control amplifying circuit connected to a next stage to the gain controllable operation amplifying circuit.

15. A semiconductor laser apparatus according to claim 7, further comprising:

a level shift circuit for shifting a level of a reference voltage input; and

input resistors having substantially a same resistance value, and respectively connected between an output terminal of the level shift circuit and each of, the non-reversal input terminal and the reversal input terminal of the amplifying circuit.

16. A semiconductor laser apparatus according to claim 15, wherein the amplifying circuit includes: a gain controllable operation amplifying circuit having a non-reversal input terminal and a reversal input terminal, to which a voltage obtained by shifting the level of the reference voltage input is input respectively, via the input resistors, and to the reversal input terminal, an output signal of the light intensity detection element being input as a negative

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feedback signal; and a gain-fixed type control amplifying circuit connected to a next stage to the gain controllable operation amplifying circuit.

5 17. A semiconductor laser apparatus according to claim 7, further comprising:

a level shift circuit connected between the amplifying circuit and the laser drive circuit.

18. A semiconductor laser apparatus according to claim 7, further comprising:

10 a high-frequency signal generating circuit for generating a high-frequency signal having a predetermined frequency; and

a high-frequency signal superimposing circuit for superimposing the high-frequency signal to the output
15 of the amplifying circuit.

19. An information recording/reproducing apparatus comprising:

a semiconductor laser apparatus including: a semiconductor laser; a light intensity detection
20 element for detecting the intensity of output light from the semiconductor laser; an amplifying circuit having a non-reversal input terminal and a reversal input terminal to which predetermined signals are respectively input, and to the reversal input terminal,
25 an output signal from the light intensity detection element is input as a negative feedback signal; a laser drive circuit for supplying a drive current to the

semiconductor laser on the basis of the output signal from the amplifying circuit; and a modulation signal current generating section for supplying a modulation signal current for adjusting an amount of output light of the semiconductor laser to the reversal input terminal of the amplifying circuit;

an optical system for irradiating output light from the semiconductor laser apparatus onto a recording medium;

a detection section for detecting reflection light from the recording medium;

a reproduction signal generating section for generating a reproduction signal based on an output from the detection section; and

a control signal generating section for generating the control signal to be supplied to the semiconductor laser apparatus.

20. An image recording apparatus comprising:

a semiconductor laser apparatus including: a semiconductor laser; a light intensity detection element for detecting the intensity of output light from the semiconductor laser; an amplifying circuit having a non-reversal input terminal and a reversal input terminal to which predetermined signals are respectively input, and to the reversal input terminal, an output signal from the light intensity detection element is input as a negative feedback signal; a laser

drive circuit for supplying a drive current to the semiconductor laser on the basis of the output signal from the amplifying circuit; and a modulation signal current generating section for supplying a modulation signal current for adjusting an amount of output light of the semiconductor laser to the reversal input terminal of the amplifying circuit;

a scanning section for scanning output light from the semiconductor laser apparatus;

an image formation section for forming an image based on the scanning of the output light by the scanning section; and

a control signal generating section for generating a control signal to be supplied to the semiconductor laser apparatus.